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ABSTRACT

Within the context of a counterbalanced design, 63 female students were tested with a computerized Minnesota Multiphasic Personality Inventory (MMPI) and a group booklet mode of administration. State anxiety was measured before and after each testing session. The correlation between the computer-based MMPI scale scores and the booklet administration scores were shown to be as high as or higher than the correlations reported for comparisons between booklet and card form administrations of booklet-booklet administrations for a college population. When compared to the booklet version, the computer mode initially produced relatively high state anxiety levels. By the end of the test, however, no difference in state anxiety levels between the two modes of administration was found. (Author)

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TECH MEMO

EQUIVALENT VALIDITY OF A COMPLETELY COMPUTERIZED MMPI

Robert E. Lushene, Harold F. O'Neil, and Thomas Dunn
Florida State University

Tech Memo No. 48
April 20, 1972
Tallahassee, Florida

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ABSTRACT

Within the context of a counterbalanced design, 63 female students were tested with a computerized MMPI and a group booklet mode of administration. State anxiety was measured before and after each testing session. The computer-based MMPI scale scores were shown to correlate as high or higher with the booklet administration scores than correlations reported for comparisons between booklet and card form administrations or booklet-booklet administrations for a college population. When compared to the booklet version, the computer mode initially produced relatively high state anxiety levels. By the end of the test, however, no difference in state anxiety levels between the two modes of administration was found.

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There have been relatively few investigations of the reliability and validity either of intelligence or personality tests in which automated equipment has been used to actually administer, score, or interpret these tests (Hansen, Hedl, & O'Neil, 1971). In the area of automated administration of intelligence tests, Elwood (1969) investigated the effects of an automated testing booth for presenting the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1955). Although the average interval between the two testing sessions was 110 days, he found a correlation of .92 between the prorated performance intelligence quotient (IQ) scores based upon three subtests. In another study (Elwood & Griffith, in press), thirty subjects were tested with a mean of 9.4 days between the two administrations of the automated WAIS. The test-retest reliability coefficients were shown to be .97, .95, and .98 for WAIS verbal IQ's, performance IQ's, and full scale IQ's, respectively.

If one considers the automated version of a test to be an entirely new test rather then merely a type of administration, then the correlation between the automated test and the traditional test would be considered an equivalent validity index. Several studies of this type have been reported for automated tests. Orr (1969) compared the automated WAIS with the traditional administration of the WAIS. In this study, using a mean intertest interval of 9.2 days, a test-retest coefficient of .93 was reported between the full scale IQ as administered be examiner and as determined by the automated administration. Hedl, O'Neil, and Hansen (1971) have developed a computer-based administration and scoring system for the Slosson Intelligence Test (Slosson, 1963). Within the context of a Latin square design, they report a correlation of .75 between the computerized and the traditionally administered Slosson Intelligence Test. The lower equivalent

validity correlation in the latter study is probably due to the fact that for the computerized Slosson Intelligence Test the computer also scored the test, whereas for the WAIS several verbal subtests were hand scored. Computer scoring of natural language input is often less reliable than human scoring of such input.

With regard to personality tests, computers have been widely used in the scoring and interpretation of personality inventories, particularly the Minnesota Multiphasic Personality Inventory (MMPI) (e.g., Fowler, 1969). However, there has been relatively little use of computers to administer such tests. One example of such an approach is reported by Dunn, Lushene, and O'Neil (in press) in which they demonstrated the feasibility of computerizing the administration, scoring, and interpretation of the entire MMPI. The validity of such an approach is reported in this paper.

It is particulary important that equivalence validity studies of automated tests be conducted. Although the very nature of the automated presentation insures a more standard stimulus presentation than do other methods, certain evidence suggests that test results may be somewhat different under automated conditions. Affective and subjective attitude reactions to computer-based administration of tests may differ from those obtained during standard administrations. For example, a number of investigators have reported that subjects tend to be more open and honest in responding to a computer, particularly if the stimulus material is of highly personal nature (Smith, 1963; Evans & Miller, 1969).

However, in the study by Hedl et al. (1971), in which a computer-based administration of an intelligence test was compared to a traditional administration, it was found that computer administration of the test led to a higher level of state anxiety than did the examiner-administered test. State anxiety (A-State) has been conceptualized by Spielberger (1966) as a transitory state or condition of the

organism that is characterized by feelings of tension and apprehension and high levels of autonomic system activity.

It could be hypothesized from the prior studies that some alteration in a computer-administered and -scored MMPI profile would result when compared to a traditionally-administered MMPI. Therefore, it seems of import to determine the equivalence-validity of the MMPI as administered by computer vs. the traditional booklet administration of the test.

Thus, it was the purpose of the present study to investigate the equivalence-validity of the computerized MMPI as compared to a standard administration of the MMPI, i.e., the group booklet form. In addition, the affective and subjective reactions to both modes of administration were investigated.

Method

Subjects

A total of 63 female students[1] participated in this experiment. All students were volunteers enrolled in psychology courses at Florida State University.

Apparatus and Materials

The IBM 1500 Computer-Assisted Instruction System (IBM, 1967) was used to present the MMPI. Students interacted with the computer via terminals which consisted of (a) cathode ray tube; (b) light pen; and (c) typewriter keyboard. The terminals were located in an air-conditioned, sound-deadened room.

MMPI

As reported in more detail by Dunn et al. (in press), the automated version of the MMPI included all 566 items. Items were presented one at a time on the cathode ray tube. Students were instructed to depress "t" for "true," "f" for "false," or "?" for "don't know" on the terminal keyboard to indicate their responses.

[1] One student was dropped from the C/B group since her F scale score was 23. Scores this high generally indicate an invalid profile.

The statement "Press space bar to continue" was inserted after each of the 566 items to allow for accurate latency recordings. Latency served as a dependent measure in a study reported elsewhere (Dunn et al., in press). The booklet form of the MMPI, with accompanying answer sheet, was also used.

Twenty-six scales were computer scored. For the automated MMPI, the IBM 1500 system was used to score on-line the MMPI, whereas a Control Data 6400 was used to score off-line the booklet form of the MMPI. The scales scored included the 13 original scales: Hypochondriasis (Hs), Depression (D), Hysteria (Hy), Psychopathic Deviate (Pd), Masculinity-Femininity (MF), Paranoia (Pa), Psychasthenia (Pt), Schizophrenia (Sc), Hypomania (Ma), Social Introversion-Extroversion (Si), Lie (L), Frequency (F), and Correction (K).

Thirteen additional scales scored were: Social Maladjustment (SOC), Depression (DEP), Feminine Interests (FEM), Poor Morale (MOR), Religious Fundamentalism (REL), Authority Conflict (AUT), Psychoticism (PSY), Organic Symptoms (ORG), Family Problems (FAM), Manifest Hostility (HOS), Phobias (PHO), Hypomania (HYP), and Poor Health (HEA) (Wiggins, 1969).

A-State

The A-State scale of the State-Trait Anxiety Inventory (STAI) developed by Spielberger, Gorsuch, and Lushene (1970) was used to measure state anxiety. The short form A-State scale consists of the five items from the total scale having the highest item-remainder correlation for the normative sample of the STAI. In a series of studies using this scale O'Neil (in press) and Leherissey, O'Neil, and Hansen (1971) report alpha reliabilities ranging from .81 to .89. This scale was administered immediately before and immediately after both booklet and computer administrations of the MMPI. When students were going through the computerized version, the anxiety scales were presented on-line. During the booklet administrations the anxiety scales were completed with paper and pencil.

Instructions for the pretest state anxiety scale asked students to describe how they felt while taking the MMPI.

Procedures

Students who signed up to participate in this experiment were randomly assigned to one of two groups:

(a) Those who were to take the computer (C) version of the MMPI first and the booklet (B) version second (C/B); and

(b) Those who were to take the booklet version of the MMPI first and the computer version second (B/C).

As students reported to the Computer-Assisted Instruction Center, they were asked to take a numbered card to identify themselves. Students who had been randomly assigned to the C/B group were asked to have a seat in the terminal room. Those who had been randomly assigned to the B/C group went to a nearby classroom.

The proctor for the C/B group then gave general instructions and information which included the number of items, the duration of the test, and some basic information about the MMPI itself. In addition, instructions were given for use of the cathode ray tube terminal.

The proctor with the B/C group gave the same instructions as those given to the C/B group, with the exception that the use of the cathode ray tube terminal was not discussed. In addition, the proctor with the B/C group distributed the test materials package. Included in this package, in this order, were: (a) STAI A-State pretest; (b) the MMPI booklet and an IBM answer sheet; and (c) the STAI A-State posttest.

All students were also instructed that their responses would be confidential since they would be identified only by number.

Procedures during the second session for both booklet and computer administrations were the same as in the first session, with the exception that students

were not given the general information about the MMPI. After students finished the posttest A-State scale, the experimenter held a debriefing session in which he explained the experiment and answered questions about the test.

Results

In order to investigate whether or not the computerized MMPI is equivalent to a booklet administration of the same test and the students' affective reactions to mode of administration, the results are divided into five sections. The first section deals with the effects of mode and order of administration on MMPI profiles. The second section deals with the effects of mode of administration on MMPI scales. The third section deals with the equivalent validity of the two modes. The fourth section deals with the effects of mode and order of administration on state anxiety, while the fifth section deals with subject preference toward mode of administration.

Effects of Mode and Order of Administration on MMPI Profiles

Figure 1 presents the mean T score profiles for the basic non-K-corrected scales for (a) the booklet administrations for each group (second for the C/B group, first for the B/C group); (b) the computer administrations for each group (first for the C/B group and second for the B/C group); (c) the first administration (booklet for the B/C group and computer for the C/B group); and (d) the second administration (computer for the C/B group and booklet for the B/C group). Figure 2 presents the same profiles for the Wiggins scale.

Discriminant function analyses were conducted in order to determine whether significant differences were present in these mean profiles.

The results of the discriminant analyses on raw scores are shown in Table 1. It will be noted, as shown in Figure 1a, that the relatively higher scores on the basic scales for the booklet administration for the B/C group resulted in significant profile differences for the booklet administration in each group. In addition, as may be seen in Figures 1c and d, respectively, the mean profiles for each group were

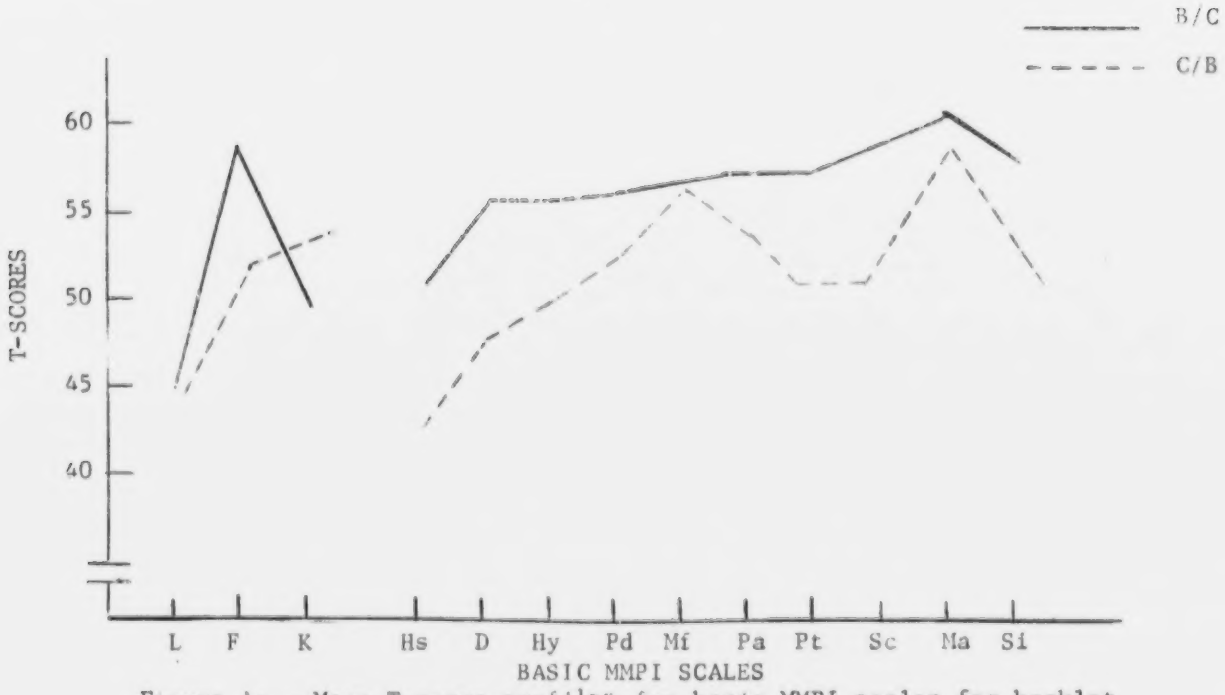

Figure 1a.--Mean T-score profiles for basic MMPI scales for booklet administrations for each group.

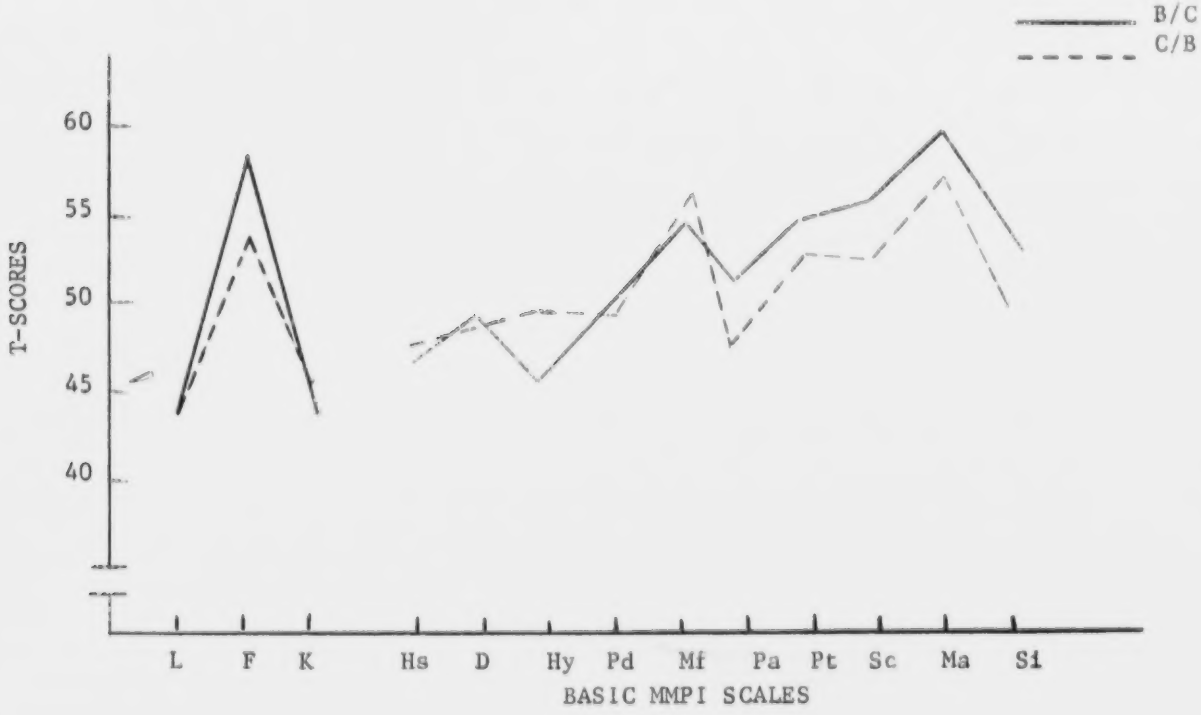

Figure 1b.--Mean T-score profiles for basic MMPI scales for computer administrations for each group.

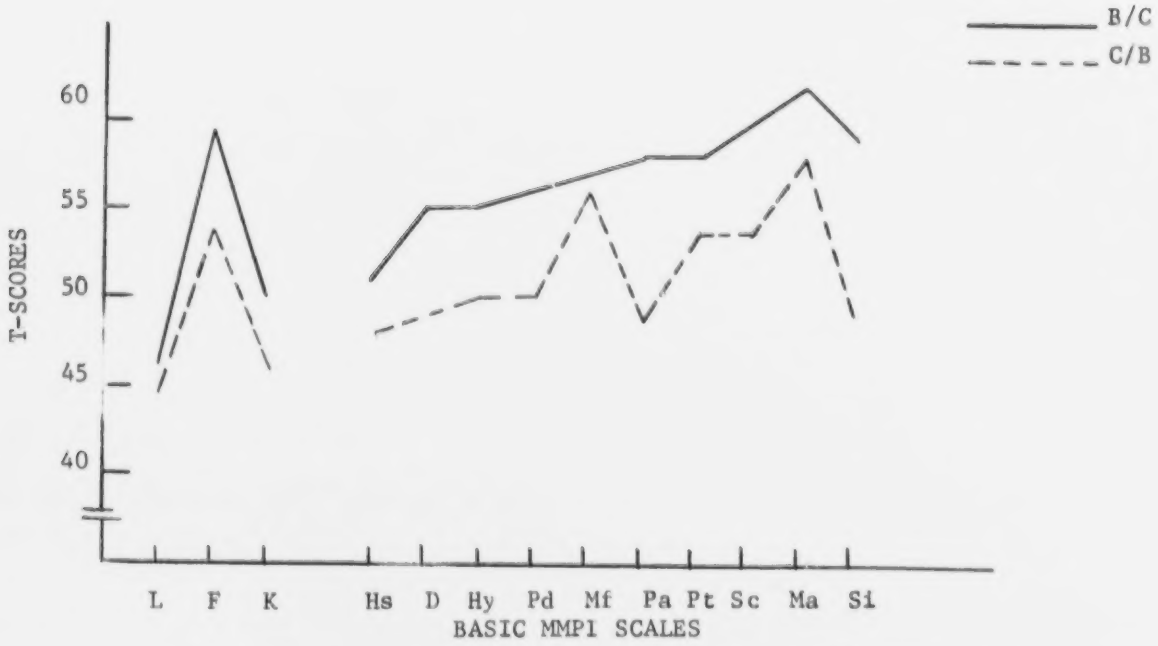

Figure 1c.--Mean T-score profiles for basic MMPI scales for first administration for each group.

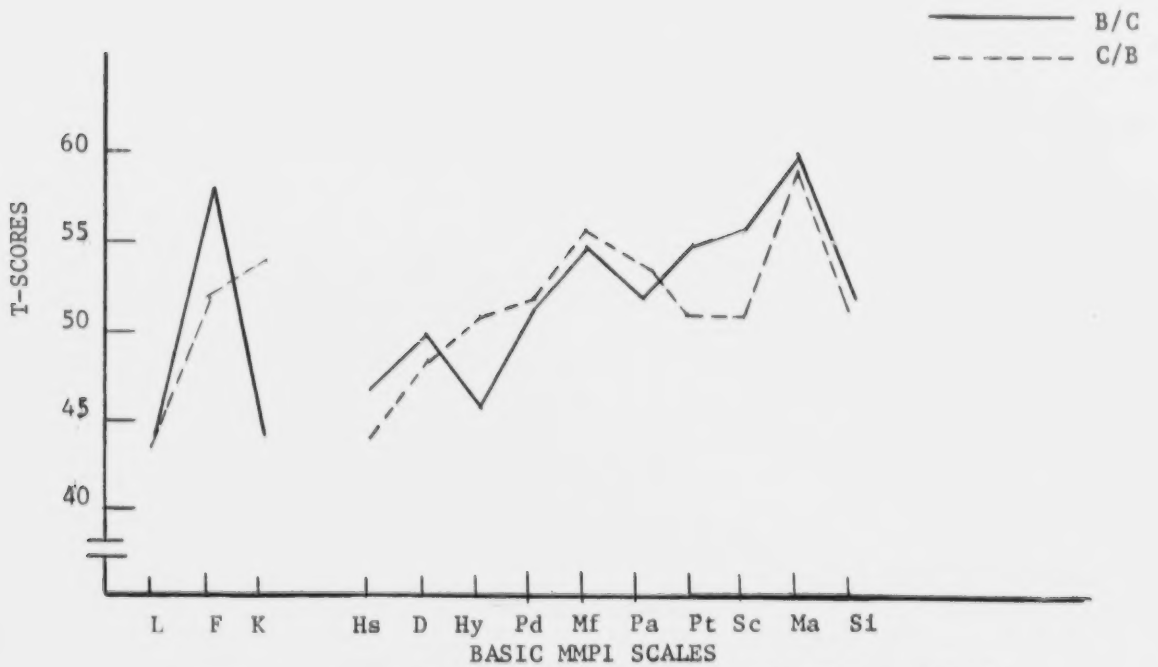

Figure 1d.--Mean T-score profiles for basic MMPI scales for second administration for each group.

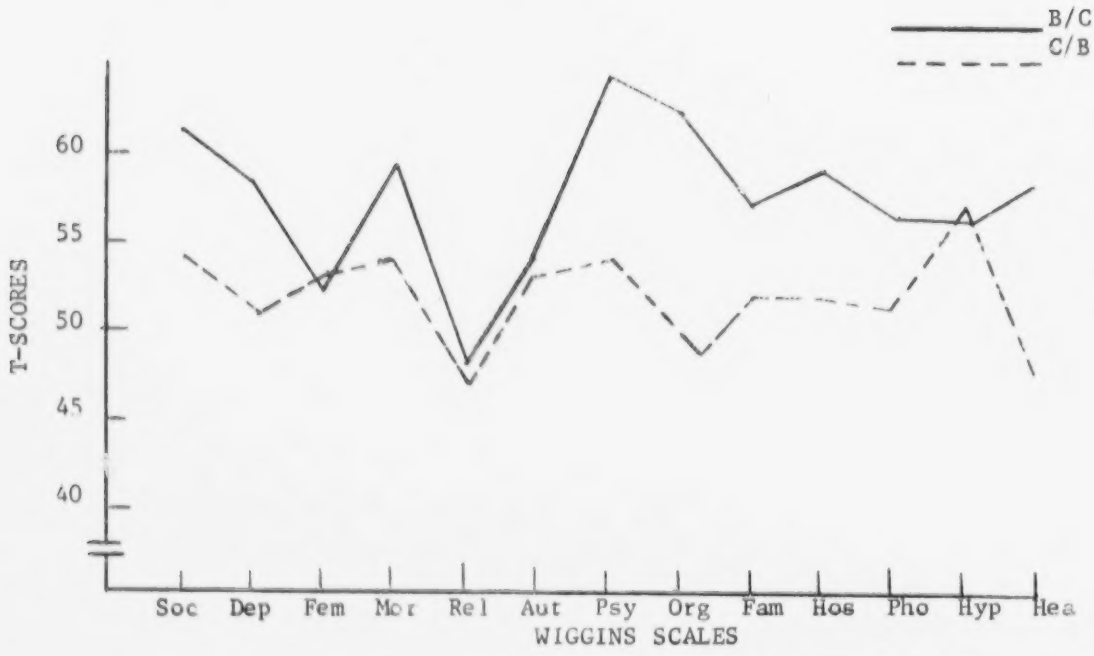

Figure 2a.--Mean T-score profiles for Wiggins scales for booklet administrations for each group.

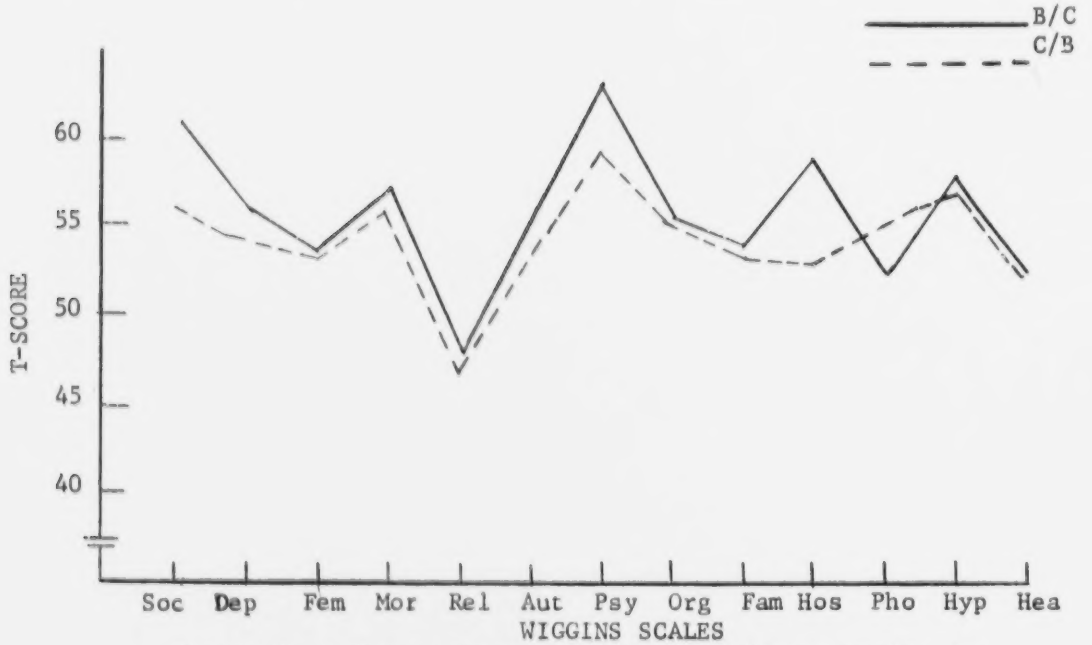

Figure 2b.--Mean T-score profiles for Wiggins scales for computer administrations for each group.

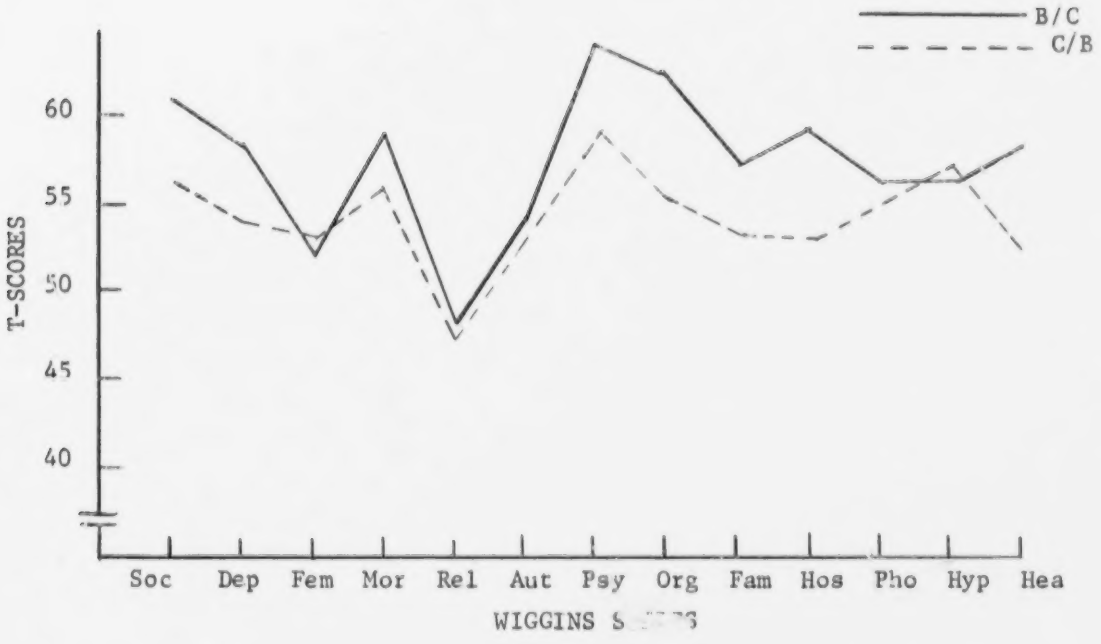

Figure 2c.--Mean T-score profiles for Wiggins scales for first administration for each group.

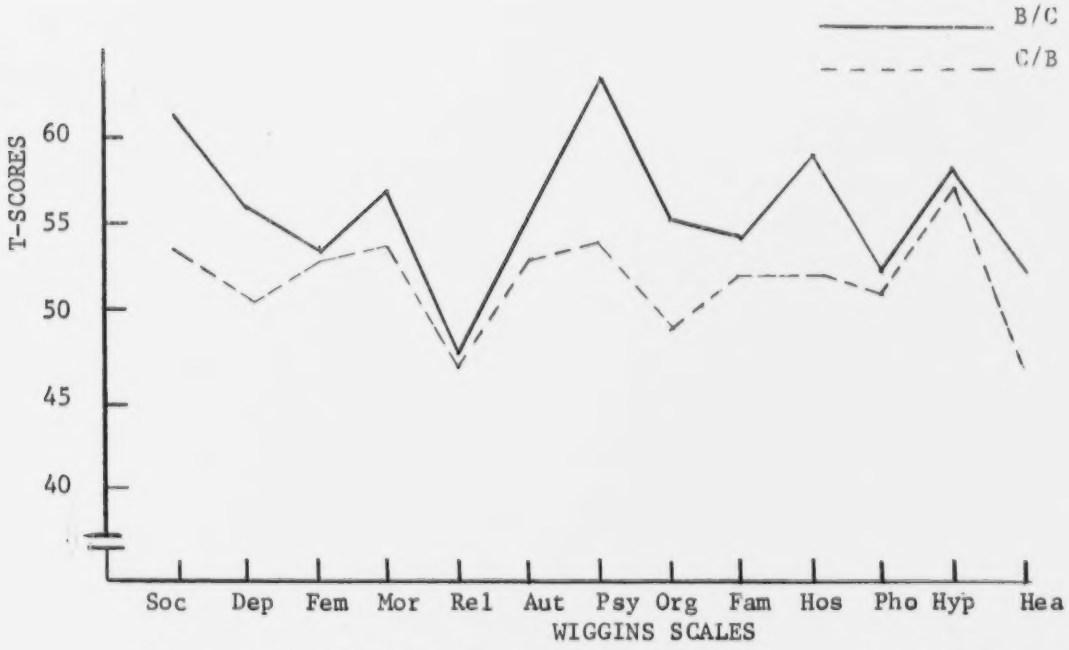

Figure 2d.--Mean T-score profiles for Wiggins scales for second administration for each group.

TABLE 1

F Ratios Based Upon the Discriminant Function Tests on the Mean Profiles of the B/C and C/B Groups for Both the Basic and Wiggins MMPI Scales

Comparison			
(a)	Booklet Administrations	2.42*	2.24*
(b)	Computer Administrations	1.14	0.95
(c)	First Administration (C vs B)	5.70**	0.88
(d)	Second Administration (C vs B)	5.67**	1.13

*p < .05; df = 26/35
**p < .01; df = 26/35

significantly different for the first test administration as well as the second administration. There were, however, no significant differences between the computer administration for each group (Figure 1b). In contrast, for the Wiggins scales there was only a significant difference between the mean profiles for the booklet administration to each group (Figure 2a); the remaining comparisons were not significant.

Effects of Mode of Administration on MMPI Scales

While the foregoing discriminant analyses were primarily designed to reveal any differences between the profiles of the mode of administration for each group and any order effects, the following analyses were concerned with pinpointing differences between the booklet and computer administrations of individual scales within the same group

The mean profiles, in terms of T-scores, for the booklet and computer administration for each group are shown in Figures 3a, b, c, and d.

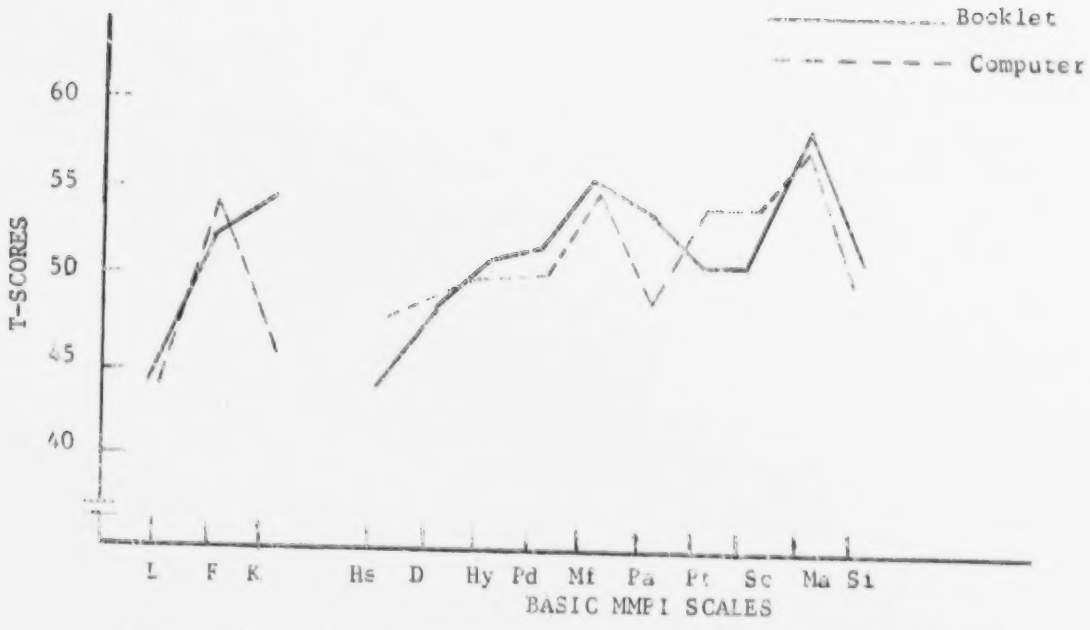

Figure 3a --Mean T-score profiles for the basic MMPI scales for the C/B group

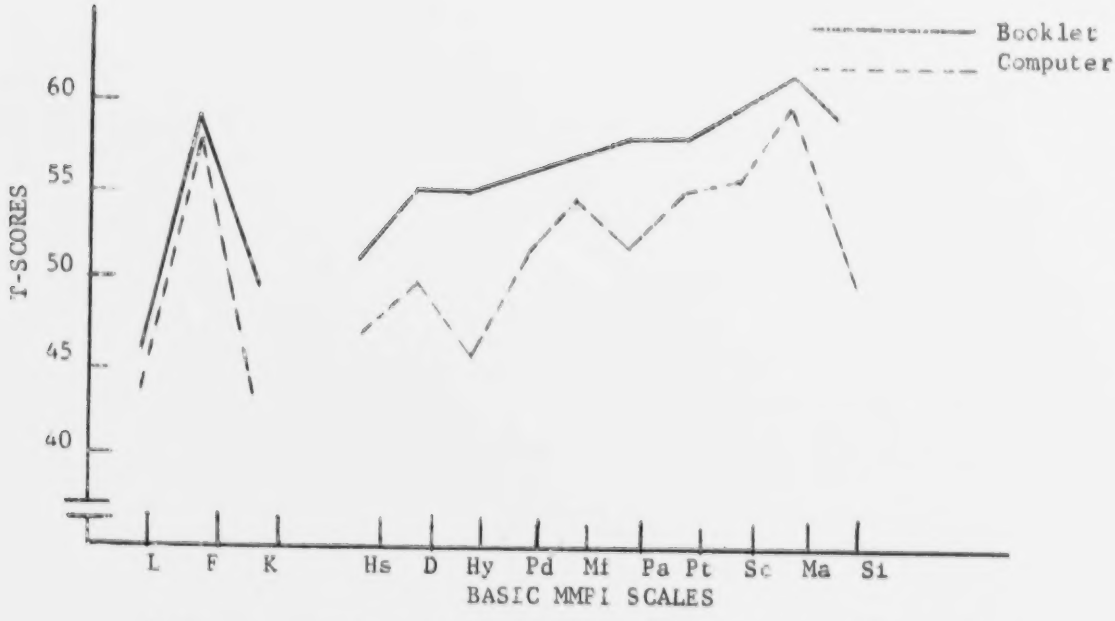

Figure 3b.--Mean T-score profiles for the basic MMPI scales for the B/C group.

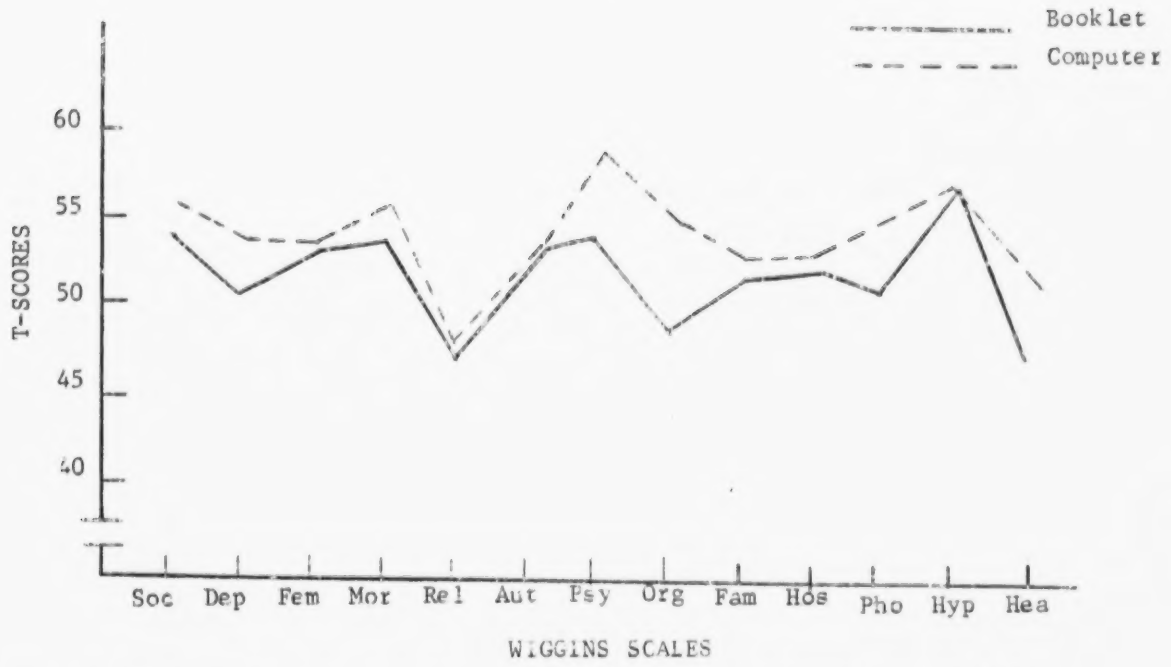

Figure 3c.--Mean T-score profiles for the Wiggins scales for the C/B group.

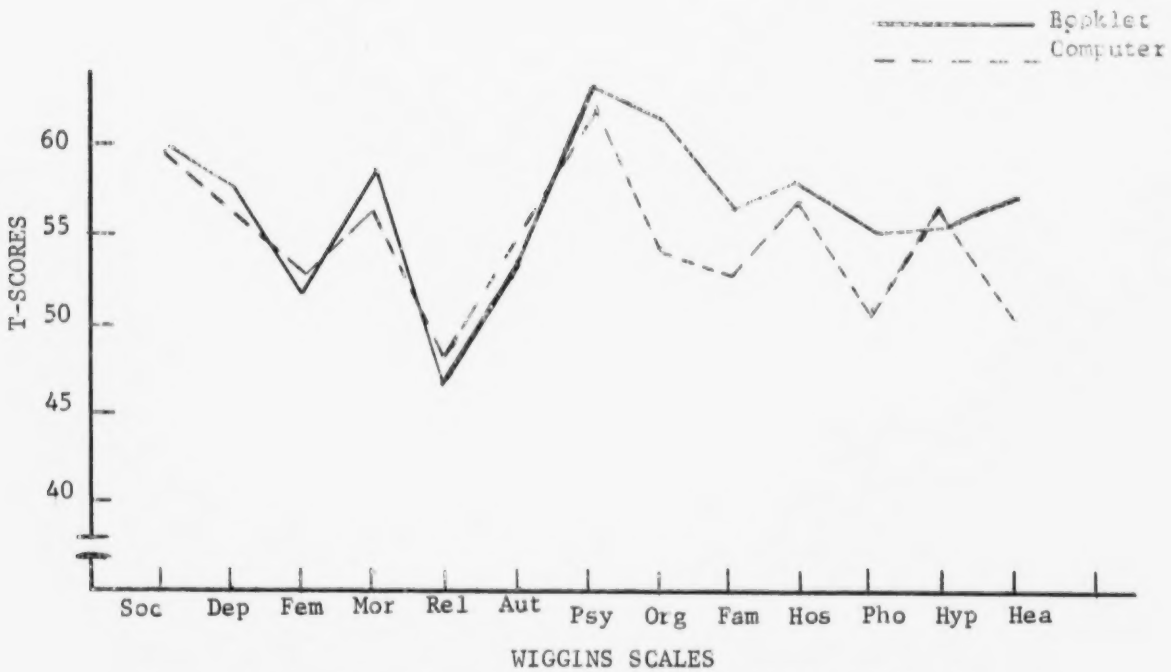

Figure 3d.--Mean T-score profiles for the Wiggins scales for the B/C group.

Correlated t-tests were conducted on all of the MMPI scales and the results are presented in Table 2. Scales which showed significant changes between the

TABLE 2

Correlated t-Tests on Mean Raw Scores for Each Test Administration for both Groups

	C/B Group			B/C Group		
Scale	Booklet Mean	Computer Mean	t	Booklet Mean	Computer Mean	t
Hs	3.73	5.85	5.14**	7.17	5.45	3.00**
D	18.24	18.61	.67	21.79	19.38	4.09**
Hy	19.42	18.94	.82	21.66	16.69	8.00**
Pd	14.36	13.48	2.38*	15.97	13.69	3.70**
Mf	39.36	39.33	.06	39.97	38.97	1.74
Pa	9.55	7.67	4.10**	10.83	8.62	3.17**
Pt	14.06	16.36	4.23**	19.38	16.97	4.26**
Sc	11.64	14.03	4.92**	18.59	15.14	3.02**
Ma	17.48	17.15	.80	18.97	18.14	1.38
Si	25.79	24.15	1.81	33.66	27.24	9.08**
L	2.52	2.03	2.77**	2.69	2.03	2.74
F	3.82	4.67	3.44**	6.45	6.00	.71
K	14.58	9.88	9.24**	12.55	9.00	7.03**
Hs+0.5K	11.27	11.03	.49	13.66	10.14	5.24**
Pd+0.4K	20.17	17.48	5.98**	21.00	17.31	5.54**
Pt+1.0K	28.64	26.24	4.51**	31.93	25.97	9.37**
Sc+1.0K	26.21	23.91	3.78**	31.14	24.14	6.20**
Ma+0.2K	20.45	19.15	2.99**	21.48	19.86	2.54*
SOC	9.48	10.36	1.69	13.07	13.21	.34
DEP	6.73	8.06	2.78**	9.90	9.07	1.37
FEM	20.76	20.70	.21	20.34	20.69	1.26
MOR	8.79	9.79	2.75*	11.17	10.24	2.07*
REL	5.55	5.52	.20	5.34	5.34	.00
AUT	6.94	7.18	.68	7.28	7.83	1.29
PSY	7.42	9.12	3.93**	11.10	10.69	.65
ORG	3.33	5.12	4.22**	7.14	5.17	3.36**
FAM	4.70	4.91	1.04	6.03	5.28	2.15*
HOS	7.88	8.12	.59	10.07	10.10	.05
PHO	7.48	9.03	4.62**	9.34	7.79	3.38**
HYP	15.52	15.45	.21	15.14	16.03	2.84**
HEA	3.30	4.58	3.86**	6.28	4.72	4.16**

*p < .05
**p < .01

booklet and computer administrations in both groups were Hs, Pd, Pa, Pt, Sc, L, and K among the basic scales and MOR, ORG, PHO, and HEA among the Wiggins scales. Scales which did not change significantly for either group were the basic Mf and Ma scales and the Wiggins SOC, FEM, REL, AUT, and HOS scales. Eight scales were significant for only one group; three of these significant differences were in the C/B group and five in the B/C group.

Equivalent Validity

The comparisons in the prior sections tend to emphasize the differences between the booklet and computer profiles. Such differences, although statistically significant, were not large in terms of absolute score change.

Since the primary objective of this study was to determine the equivalence-validity of a computer administration of the MMPI compared to a booklet form, test-retest correlations were calculated between the computer and booklet scores for each scale. These correlations were computed separately for each group as well as the total sample. These correlations are presented in Table 3.

All of the test-retest coefficients were significant beyond the .01 level and range from a low of .47 to a high of .95 for the C/B group, a low of .42 to a high of .93 for the B/C group, and a low of .45 to a high of .93 for the total sample.

Effects of Mode and Order of Administration on State Anxiety

A five-item STAI A-State scale was administered both before and after each test administration. An overall analysis of variance was performed on these data with groups, mode of administration, and pre-post as the independent variables and the A-State scores as the dependent variable. The triple Groups x Mode x Pre-Post interaction was significant beyond the .001 level ($F = 26.99$; $df = 1/168$). The nature of this interaction can be seen in Figure 4.

TABLE 3

Test-Retest Coefficients for MMPI Scales for Each Group

MMPI SCALE	C/B Group	B/C Group	Both Groups
Hs	.68	.76	.63
D	.73	.85	.77
Hy	.57	.73	.52
Pd	.88	.76	.83
Mf	.80	.73	.76
Pa	.47	.42	.45
Pt	.87	.92	.85
Sc	.91	.83	.80
Ma	.85	.73	.80
Si	.80	.90	.83
L	.83	.66	.75
F	.89	.67	.75
K	.80	.72	.77
Hs+0.5K	.51	.68	.54
Pd+0.4K	.83	.68	.75
Pt+1.0K	.79	.86	.78
Sc+1.0K	.82	.78	.75
Ma+0.2K	.84	.65	.76
SOC	.84	.93	.89
DEP	.83	.83	.81
FEM	.83	.82	.82
MOR	.92	.87	.88
REL	.95	.93	.94
AUT	.85	.85	.85
PSY	.84	.83	.81
ORG	.79	.75	.67
FAM	.93	.86	.88
HOS	.81	.74	.77
PHO	.88	.86	.81
HYP	.82	.81	.80
HEA	.73	.85	.73

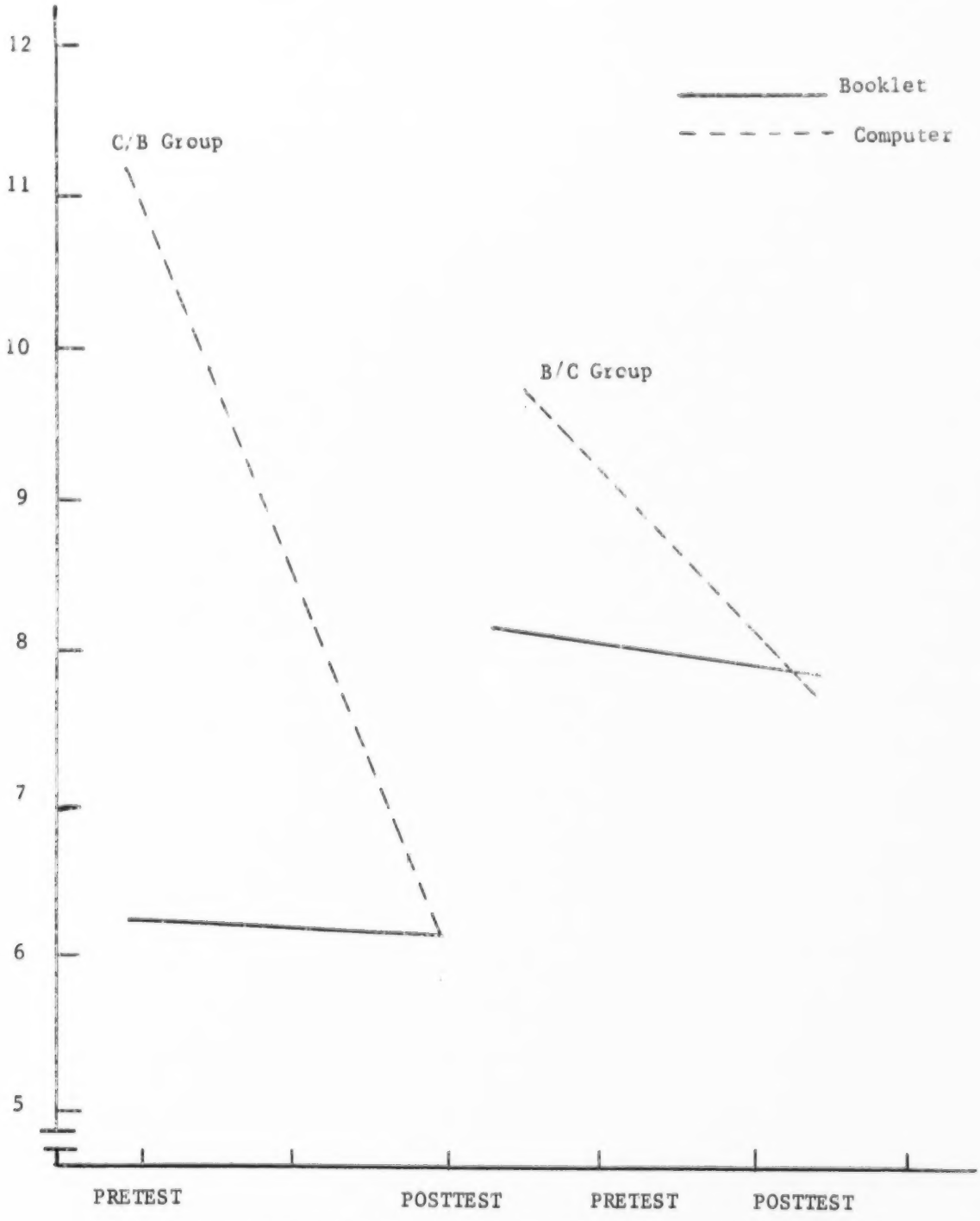

Figure 4.--Mean STAI A-State scores for each group both before and after the booklet and computer administrations.

Subsequent analyses indicated that the decrease in state anxiety scores during the computer administration was statistically significant beyond the .01 level for both groups, while the change during the booklet administration was non-significant for each group. Further, it will be noted that the decrease in anxiety scores was much greater for the C/B group than for the B/C group.

Correlated t-tests on the initial pretest scores for the computer and booklet administration revealed statistically significant initial differences (beyond the .01 level) for each group. There were, however, no significant differences between the booklet and computer anxiety scores at posttest A-State measurement.

Mode of Administration Preference

In order to study the subjective preference for mode of administration, the subjects were asked to indicate which version of the MMPI they preferred after having completed both versions. For the C/B group (which answered the question after completing the booklet version), 15 students preferred the computer version and 14 preferred the booklet version. For the B/C group (which answered the question after completing the computer version), 20 preferred the computer and 14 preferred the booklet. Overall, therefore, 35 students preferred the computer administration to 28 for the booklet. However, these differences in preference were not significant ($\chi^2 = .10$; $df = 1$; $p = .75$).

Discussion

Since regression towards the mean has often been observed upon MMPI retesting (Dahlstrom & Welsh, 1960), the two groups were given the booklet and computer administrations in counter-balanced order. However, the results in the present study do not consistently reveal such regression toward the mean. While the computer profile is generally lower for the B/C group, the

booklet profile is not consistently lower than the computer profile for the C/B group.

Much of the between-group variance seems to be attributable to the relatively higher scores on the booklet administration for the B/C group. It is also of some interest to note that although the booklet scores for the B/C group were somewhat elevated over their computer scores on the basic scales, the profiles were quite similar and the test-retest coefficients were consequently rather high in spite of the absolute score differences. No consistent explanation for these results is immediately apparent. Likewise, the anxiety data indicate that the B/C group, for some reason, was a more state-anxious group initially than was the C/B group. However, the data do not demonstrate any consistent scale bias as a result of computer administrations of the MMPI.

Although a number of scales showed significant differences between the computer and booklet administration for the same group, the differences were often not large (less than 2 score points). The test-retest coefficients were as high as those reported for comparisons between the booklet and card form of the MMPI with a one-week interval (e.g., Cottle, 1950; Gilliland & Colgin, 1951; MacDonald, 1952). The median scale test-retest coefficient in those studies was .76, .67, and .72. The values also are in line with one-week test-retest coefficients for the booklet alone; the median coefficient in a study by Cofer, Chance, and Judson (1949) was .68, and .81 in a study by Windle (1955).

The finding that the computer administrations to the two groups were not significantly different as were the booklet administrations at least implies that computer administration of personality tests results in more reliable measurement. Perhaps this is due to removal of such systematic sources of variance as administrator personality.

The findings with respect to the anxiety data suggest that the first administration of the test is met with more anxiety than is the second. This finding supports a similar interpretation advanced by Dahlstrom and Welsh (1960) to explain, at least in part, the regression towards the mean effect noted on retesting. In this study only the B/C group (highest A-State) showed regression toward the mean. It is also apparent that, compared to the booklet version, the computer initially produces rather high anxiety levels. By the end of the test, however, no differences in anxiety level between the two modes was found.

The fact that the computer profiles were not more "deviant" than the booklet profiles suggests that perhaps this initial anxiety level is not maintained throughout the test but quickly dissipates once the subject is comfortable responding to the computer; this explanation is further supported by subjective reports which indicated that no difference in preferences existed towards the two modes of administration. The A-State results are in contrast to Hedl et al. (1971), in which high levels of A-State were maintained throughout a computerized intelligence test.

While the data reported here must be regarded as preliminary, it appears that administration of a computerized MMPI is at least as valid as administration via the booklet version. Further, computerized administration offers additional conveniences in terms of immediate on-line scoring and interpretation.

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